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Original Research Article

Production, Quality and Profitability of Chickpea (*Cicer arietinum*) + Indian mustard (*Brassica juncea*) Intercropping as Influenced by Phosphorus Fertilization in Rain Fed Condition

Pramod Kumar Yadav[1], Satya Prakash Singh[2*], A. P. S. Dohare[2] and Shailendra Singh[2]

[1]Department of Agronomy Brahmanand Post Graduate College, Rath, Hamirpur, U.P., India
[2]Krishi Vigyan Kendra Belipar, Gorakhpur UP, India
**Corresponding author*

A B S T R A C T

A field experiment was conducted during winter seasons of 2007-08 and 2008- 09 at Research Farm of Brahmanand Mahavidyalaya, Rath, Hamirpur (U.P.) Treatments comprised 5 cropping systems viz, sole chickpea, sole Indian mustard, CP+M intercropping in 2:1, 4:2 and 6:3 row ratios; and 4 levels of phosphorus (0, 30, 60 and 90 kg P/ha) applied to both crops on row basis. Effect of treatments was evaluated on crops yield, seed quality and economics. Seed yield of sole crops was recorded significantly highest. Amount intercropping 6:3 row ratio of CP+M being at par with 4:2 row ratio produced higher seed yield of chickpea than 2:1 row ratio of CP+M intercropping which was at par with 6:3 row ratio, and significantly higher than the yield under 2:1 row ration of CP+M intercropping, protein content in chickpea seed was estimated highest in sole stand which was significantly higher only over 2:1 row ratio of intercropping in pooled analysis, Oil content in mustard seed was not affected significantly maximum of Rs. 31450/ha with 2.48 B:C ratio in 6:3 row ratio of CP+M intercropping. Increasing levels of phosphorus increased seed yield, protein content in chickpea seed, oil content in mustard seed and not profit with B:C ratio significantly up to 60 kg P/ha application. Thus intercropping of CP+M in 6:3 row ratio along with 60 kg P/ha proved superior for higher productivity and profitability from chickpea + Indian mustard intercropping system.

Keywords

Chickpea, Indian mustard, Intercropping system, phosphorus, yield seed quality, Economics

Introduction

Chickpea is an important pulse crop of India, while Indian mustard is well estabilished and popular among oilseeds. Both crops grown intensively in Bundelkhand zone of Uttar Pradesh either in sole or mixed stands. The result of recent researches have indicated that intercropping of both these crops in proper row proportions may increase the total crops production par unit area, because of better utilization of natural and applied resources. Advantages of these in general, are more pronounced in stress environments *(Yadav et al.,* 1998). However, proper nutrient supply is an important aspect of intercropping for its success.

Among nutrients, phosphorus has its own importance in pulse and oilseed crop. Keeping into consideration the importance of chickpea mustard intercropping, the present, study was undertaken with different row propertions of chikcpea and mustard, and different levels of phosphorus

application in rainfed condition of Bundelkhand zone of Uttar Pradesh.

Materials and Methods

The field experiment was conducted during rabi 2007-08 and 2008-09 at Research Farm of Brahmanand Mahavidyalaya, Rath, Hamirpur (U.P.) The treatment combinations comprising 5 intercropping systems viz., sole chickpea, sole Indian mustard, CP+M in 2:1, CP+M in 4:2 and CP+M in 6:3 in row ratios in replacement series; and 4 levels of phosphorus viz. 0, 30, 60 and 90 kg P/ha were tested in split plot design keeping intercropping systems in main plots and P levels in sub plot with 3 replications. Chickpea variety 'Radhey' and Indian mustard variety 'Vardan' were used in the experiment. The sowing was done at 40 cm rows apart in both cases of sole and intercropping using 80 and 5 kg. seed/ha of chickpea and Indian mustard, respectively on the basis of sown area of each crop in different treatments. Plant spacing in mustard was maintained 10 cm by thinning. Sowing of both crops was done after pre-sowing irrigation, on 03.11.2007 and 12.11.2008 during two years.

Harvesting of Indian mustard was done on 5.3.2008 and 8.3.2009 while chickpea was harvested on 8.3.2008 and 6.3.2009 in two years of study. An uniform dose of 18 kg. N/ha in chickpea and 60 kg. N/ha in Indian mustard was applied to all treatment plots. All fertilizers were applied on the basis of proportionate area under each component crop in intercropping system at the time of sowing. The soil of experimental field was silty loam, slightly alkaline (pH 7.8), low in organic carbon (4.2%) and contained 25.27 kg/ha available P and 202 kg/ha available K content. The rainfall received during the cropping season were 9.6 and 16.0 mm in 2007-08 and 2008-09, respectively.

Results and Discussion

Crop yield

Significantly highest seed and stover yields of chickpea and Indian mustard (Table 1) were recorded in their sole cropping which was attributed to more plant population per unit area. Similar results were reported by *Kumar et al.,* (2006). Seed yield of chickpea in intercropping systems was significantly highest under 6:3 row ratio of CP+M followed by 4:2 and 2:1 row ratios of intercropping with significant variation among each. Straw yield followed the same pattern, but with little differences among row ratios. It might be due to the reason that in wider row ratios, less population of chickpea was affected by Indian mustard than in narrower row ratios of CP+M. These results support of findings of *Chand and Tripathi* (2005). Seed and stover yields of mustard in intercropping system were highest in 4:2 row ratio of CP+M, but these were found significantly higher only over the seed and stover yields under 2:1 row ratio of CP+M. It might be due to the reason that in 4:2 row ratio, both rows of Indian mustard took full advantage of resources and benefited by association of chickpea. *Chand and Tripathi* (2005) also observed similar results.

Increasing levels of phosphorus increased seed and stover yields of both component crops significantly up to 60 kg P/ha beyond which a depressive effect on seed yield of chickpea was observed at 90 kg P/ha application (Table 1). The favourable response of crops yield to increasing levels of P) fertilization might be attributed to it's important role in improving root nodules in chickpea and in translocation of photosynthates from source to sink *(Parihar and Tripathi*, 1989). These results confirm the findings of *Kumar and Singh* (2006).

Table.1 Yield, protein and oil contents in component crops as influenced by intercropping systems and phosphorus application

Treatments	Chiekpea									Indian mustard								
	Seed Yield (q/ha)			Straw yield (q/ha)			Protein content in seed (%)			Seed Yield (q/ha)			Stover yield (q/ha)			Oil Content (%)		
	07-08	08-09	Pooled	07-08	08-09	Pooled	07-08	08-09	Pooled	07-08	08-09	Pooled	07-08	08-09	Pooled	07-08	08-09	Pooled
Intercropping systems																		
Sole chickoea	14.01	13.44	13.73	21.06	20.26	20.26	21.70	21.73	21.72	-	-	-	-	-	-	-	-	-
Sole mustard	-	-	-	-	-	-	-	-	-	11.64	11.02	11.33	41.75	39.24	40.50	39.51	39.52	39.52
CP+M (2:1)	8.69	8.21	8.45	18.11	17.46	17.79	21.01	21.05	21.03	5.48	5.25	5.37	18.34	17.29	17.82	39.50	39.47	39.49
CP+M(4:2)	10.23	9.63	9.93	18.45	17.88	18.21	21.45	21.41	21.43	6.28	6.01	6.15	21.46	20.22	20.84	39.68	39.64	39.66
CP+M (6:3)	11.19	10.72	10.96	19.21	18.60	18.91	21.49	21.53	21.51	6.02	5.79	5.89	20.77	19.57	20.17	39.55	39.60	39.58
S.Ed. ±	0.39	0.43	0.31	0.59	0.57	0.46	0.29	0.30	0.26	0.22	0.32	0.18	0.97	0.87	0.70	0.10	0.13	0.10
CD at 5%	0.95	1.06	0.68	1.44	1.39	0.00	NS	NS	0.57	0.55	0.78	0.39	2.38	2.13	1.53	NS	NS	NS
Phosphorus (kg/ha)																		
0	9.00	8.73	8.87	16.67	16.17	16.42	19.54	19.55	19.55	5.61	5.37	5.49	20.34	19.20	19.77	38.83	38.92	38.88
30	11.14	10.61	10.88	18.79	18.12	18.46	21.20	21.21	21.21	7.0	6.68	6.84	24.68	23.27	23.98	39.27	39.34	39.31
60	12.20	11.53	11.87	20.63	19.81	20.22	22.40	22.41	22.41	8.12	7.73	7.93	27.79	26.22	27.01	39.97	39.93	39.95
90	11.78	11.20	11.49	20.83	20.10	20.47	22.50	22.54	22.52	8.70	8.25	8.48	29.50	27.62	28.56	40.18	40.05	40.12
S.Ed. ±	0.54	0.63	0.44	0.83	0.84	0.66	0.42	0.42	0.35	0.34	0.46	0.30	1.48	1.25	1.14	0.13	0.16	0.11
C.D. at 5%	1.12	1.29	0.86	1.72	1.73	1.29	0.86	0.86	0.69	0.71	0.96	0.59	3.05	2.59	2.23	0.26	0.32	0.22

Table.2 Economic Parameters of chickpeas+ Indian mustard intercropping as influenced by intercropping systems and phosphorus application

Treatments	Total cost cultivation	Gross return (000 Rs./ha)			Net Profit (000(Rs/ha)			B.C. ratio		
		2007-08	2008	Pooled	2007-08	2008-09	Pooled	2007-08	2008-09	Pooled
Intercropping										
Sole chickpea	13057	38.519	36.957	37.738	25.462	23.900	24.681	1.95	1.83	1.89
Sole mustard	10557	27.452	25.959	26.705	16.895	15.403	16.149	1.59	1.45	1.52
CP+M(2:1)	12657	37.304	35.418	36.361	24.630	22.762	23.969	1.94	1.79	1.87
CP+M(4:2)	12657	43.170	40.853	42.012	30.513	28.197	29.355	2.40	2.22	2.31
CP+M(6:3)	12657	45.280	43.184	44.232	32.373	30.528	31.450	2.55	2.40	2.48
S.Ed. =	-	1.300	1.288	1.152	0.968	0973	0.856	0.07	0.06	0.05
CD at 5%	-	2.997	2.969	2.442	2.233	2.243	1.815	0.17	0.15	0.11
Phosphorus(kg/ha)										
0	11760	30.656	29.573	30.115	18.882	17.813	18.348	1.59	1.50	1.55
30	12131	37.839	36.66	36.952	25.708	23.935	24.821	2.10	1.95	2.03
60	12502	42.239	40.030	41.135	29.737	27.528	28.632	2.36	2.19	2.28
90	12873	42.444	40.228	41.336	29.571	27.355	28.463	2.29	2.11	2.20
S.Ed. =	-	1.568	1.539	1.372	1.182	1.162	1.012	0.09	0.08	0.07
C.D. at 5%	-	3.202	3.143	2.689	2.415	2.372	1.984	0.18	0.17	0.14

Seed quality

Protein content in chickpea seed and oil content in mustard seed (Table 2) were not affected by intercropping systems, however protein content in chickpea seed was found significantly higher in sole stand than in 2:1 row ratio of CP+M intercropping only in pooled analysis. Similar results have been reported by *Singh and Yadav* (1992) in chickpea and by *Chand and Tripathi* (2005) in Indian mustard.

Protein content in chickpea seed and oil content in mustard seed increased with increasing levels of phosphorus significantly up to 60 kg P/ha (Table 1). It might be due to more uptake of N in chickpea because of better nodulation at higher levels of P application. *Singh et al.,* (1997) also reported that application of P significantly increased the uptake of N in chickpea by 30 - 40% at 60 kg P/hga over control. Increase in seed oil content of mustard may be ascribed because it is a constituent of phospholipids and is essential for the synthesis *(Maraghatham and Challambudu,* 2000). These results corroborate to the findings of *Chand and Tripathi* (2005).

Economics

Gross return, net profit and benefit cost ratio were recorded highest with CP+M intercropping in 6:3 row ratio and significantly lowest in sole mustard (Table 2). However, difference in gross return between 6:3 and 4:2 row ratios of CP+M intercropping was not significant. On pooled basis of two years results, CP+M intercropping in 6:3 row ratio earned significantly maximum net profit of Rs. 31450/ha which was found 7.1, 27.4, 32.7 and 94. per cent higher than the net profit values of CP+M intercropping in 4:2 row sole ratio, sole chickpea, CP+M intercropping in 2:1 row ratio and sole mustard. Better performance of 6:3 and 4:2 row ratios of CP+M intercropping might be associated with higher seed yield of component crops in case of various economic parameters of the system. *Kumar and Singh* (2005) also reported similar results.

Gross return and net profit along with B: C ratio increased with increasing P levels significantly upto 60 kg P/ha (Table 2). These might be attributed to higher seed production of both component crops with increasing P levels in a similar way. These results are in accordance to the findings of *Kumar and Singh* (2006).

In interaction effect between cropping systems and phosphorus levels was not found significant in any of the crop characters studied in present experiment.

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